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## **CO<sub>2</sub> dissolution in formation water as dominant sink in natural gas fields**

### **(Abstract)**

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## CO<sub>2</sub> dissolution in formation water as dominant sink in natural gas fields

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A primary concern facing Carbon Capture and Storage (CCS) technology is the proven ability to safely store and monitor injected CO<sub>2</sub> in geological formations on a long-term basis. However, it is extremely challenging to assess the long-term consequences of CO<sub>2</sub> injection into the subsurface from decadal observations of existing CO<sub>2</sub> disposal sites.

Noble gases are conservative tracers within the subsurface, and combined with carbon stable isotopes, have proved to be extremely useful in determining both the origin of CO<sub>2</sub> and how the CO<sub>2</sub> is stored within natural CO<sub>2</sub> reservoirs from around the world [1,2]. This presentation will identify and quantify the principal mechanism of CO<sub>2</sub> phase removal in nine natural gas fields in North America, China and Europe. These natural gas fields are dominated by a CO<sub>2</sub> phase and provide a natural analogue for assessing the geological storage of CO<sub>2</sub> over millennial timescales. Our study highlights that in seven gas fields with siliciclastic or carbonate-dominated reservoir lithologies, dissolution in formation water at a pH of 5–5.8 is the major sink for CO<sub>2</sub> [2]. This pH range is obtained by modelling the carbon isotope fractionation that results from dissolution of CO<sub>2</sub>(g) to varying proportions of H<sub>2</sub>CO<sub>3</sub>(aq) and HCO<sub>3</sub><sup>-</sup>(aq). This is a major breakthrough as accurate subsurface pH measurements are notoriously difficult to obtain. In two fields with siliciclastic reservoir lithologies, some CO<sub>2</sub> loss through precipitation as carbonate minerals cannot be ruled out, but this is minor compared to the amount of CO<sub>2</sub> lost to dissolution in the formation water within the same fields.

Our findings imply mineral fixation is a minor CO<sub>2</sub> trapping mechanism within natural reservoirs and hence suggests long-term models of geological CO<sub>2</sub> storage should consider the potential mobility of CO<sub>2</sub> dissolved in water.

[1] Gilfillan et al., (2008) *GCA* **72**, 1174-1198.

[2] Gilfillan et al., (2009) *Nature*, doi:10.1038/nature07852